

Species Diversity, 2004, 9, 359–366

A New Species of the Genus *Eosentomon* (Insecta: Protura: Eosentomidae) from Rishiri Island, Hokkaido, Northern Japan

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(Received 7 July 2003; Accepted 17 May 2004)

A new species of the proturan genus *Eosentomon*, *E. rishiri*, is described from Rishiri Island, Hokkaido, northern Japan. The present species is characterized by the position and/or shape of sensilla *c'* and *b* on the foretarsus, the absence of A5 on abdominal tergites IV–VII, and the position and shape of P1a on tergites II–VII. An updated key to the Japanese species of *Eosentomon* is presented.

Key Words: Protura, *Eosentomon*, new species, Japan, key.

Introduction

Eosentomon Berlese, 1908, the largest genus in Protura, now comprises more than 260 species (Szeptycki 2003) and is common in most areas of the world. Sixteen species of the genus have so far been recorded from Japan (Imadaté 1995).

In a faunal survey of soil animals on Rishiri Island, an unusual species of *Eosentomon* was collected, which has short and capitulate accessory setae P1a on abdominal tergites I–VII and lacks the anterior setae A5 on abdominal tergites IV–VII. Among congeneric species, these two setal features are very rare. Moreover, the posterior setae P5 are displaced anteriorly on tergites IV–VII. For these reasons, the specimens from Rishiri Island are described as a new species of *Eosentomon*, and an updated key to the Japanese congeners is provided as well.

Material and Methods

Proturans were collected from litter and soil of a coniferous forest on Rishiri Island, Hokkaido, in Tullgren funnels. All the extracted proturans were individually mounted in polyvinyl-lactophenol medium. The slides were dried for three days in an oven at 60°C.

The type specimens of the present new species are deposited in the National Science Museum, Tokyo (NSMT).

The indices and terminology of body chaetotaxy are after Imadaté (1974), and the terminology of head and hind tarsus chaetotaxy and shape of setae, sensilla, and microsetae are after Bernard (1990).

Taxonomy

***Eosentomon rishir* sp. nov.**
(Figs 1–17)

Eosentomon sp. Ri: Nakamura 2003; 67.

Diagnosis. Belonging to *wheeleri*-group of Tuxen (1964). Sensilla posterior to pseudoculus distinct. Foretarsal sensilla *b*, *t2*, and *b'2* spatulate, *b'1* and *c'* broad, and *c'* posterior to base of $\alpha 6$. P1a on thoracic tergites and abdominal tergites I–VII short, capitate, and situated at same level with P1 and P2; A5 absent on tergites IV–VII; P2a on tergite VIII linear.

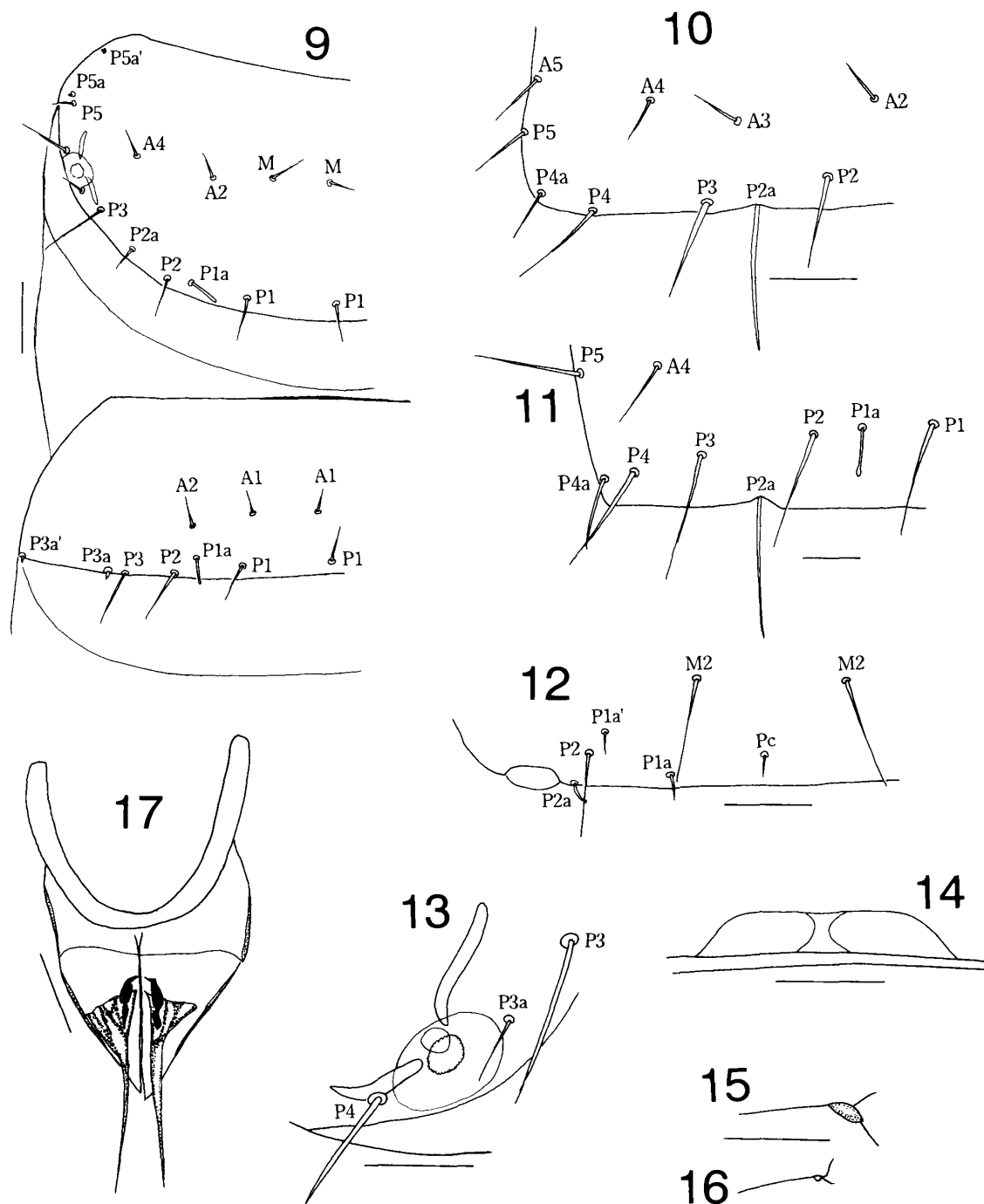
Description. *Body length.* 760–1138 μm (1138 μm in holotype in expanded condition).

Head. 106–117 μm long, 76–83 μm wide. Anterior additional setae absent; posterior additional setae (*pa*), seta *m4*, and anterior and posterior sensilla (*as* and *ps*) present; subposterior setae (*sp*) about 1.5 times longer than posterior setae (*p*) (Fig. 1). Clypeal apodemes distinct (Fig. 2). Labral setae (*b*) present; rostral setae (*rs*) slightly inflated basally, shorter than subrostral setae (*s*) (Fig. 2). Maxillary palpus with two sensilla, dorsal sensillum (*d*) 7.9–8.6 μm long, longer than lateral sensillum (*l*) 6.3–6.6 μm in length (Fig. 3). Digits of galea small, blunt, and subequal in length and shape to each other (Fig. 4). Mandible with two teeth. Pseudoculus almost circular with no inner structure (Fig. 5), about 10 μm wide, PR=11.2–11.5. Sensilla posterior to pseudoculus distinct, 2–3 μm long (Fig. 5).

Legs. Foretarsus length (Figs 6, 7) 76–83 μm , claw 18–20 μm , TR=4.0–4.4, empodium slightly shorter than claw, 16–17 μm , EU=0.83–0.90, S-shaped seta subequal to or slightly longer than claw, 18–22 μm . Dorsal sensillum *t1* situated halfway between bases of $\alpha 3$ and $\alpha 3'$, BS=0.93–0.99; *t2* spatulate; *t3* thin. Exterior sensillum *a* normal; *b* rounded spatulate; *c* linear; *d* relatively long and surpassing base of $\alpha 5$; *e* normal with long, spatulate dilatation; *f1* thin and relatively long; *f2* thin and small; *g* normal with long, spatulate dilatation. Interior sensillum *a'* thin; *b'1* broad and nearer to base of $\delta 3'$ than to that of $\delta 4'$; *b'2* weakly spatulate and narrower than *t2*; *c'* broad and posterior to base of $\alpha 6$, situated on line between bases of $\alpha 6$ and $\delta 4'$. Row of tubercles present between bases of $\delta 3$ and *b*. Pores present just proximal to $\alpha 3'$ and *y*. Middle tarsus 36–43 μm long, claw 12–14 μm ; hind tarsus 49–54 μm long, claw 13–14 μm ; empodia of both tarsi very short. On hind tarsus, setae D2 and D5 spine-like, but D2 slightly more slender than D5 (Fig. 8).

Body. Tracheal camerae relatively long, distally contracted (Fig. 13). Chaetotaxy as in Table 1 and Figs 9–12. On thoracic tergites II and III, P1a sensillum-like and linear, situated at same level with P1 and P2, nearer to P2 than to P1; P2a seta-like and situated at same level with P2 and P3 (Fig. 9). On thoracic tergite III, microchaetae P5a and P5a' present (Fig. 9).

Abdominal tergite I with microchaetae P3a and P3a' (Fig. 9); tergites II and III with five pairs of anterior setae, A1 to A5 (Fig. 10); tergites IV–VI with three pairs, A1, A2, and A4; tergite VII with one pair, A4 (Fig. 11); and tergites IX–XI with four pairs of setae. On tergites II–VII, P2 situated at same level with P1, anteriorly to row of P3 and P4 (Fig. 11). On tergites IV–VII, P5 displaced anteriorly and situated at almost same level with A4 (Fig. 11). On tergites I–VII, P1a situated in same row



Figs 9–17. *Eosentomon rishir* sp. nov., holotype, female. 9, Thoracic tergite III and abdominal tergite I, left half; 10, abdominal tergite III, left half; 11, abdominal tergite VII, left half; 12, abdominal tergite VIII, left half; 13, tracheal camerae on thorax III; 14, central lobe on abdominal tergite VI; 15, laterostigma IV; 16, laterostigma V; 17, squama genitalis. Scale bars: 20 μ m for Fig. 9; 10 μ m for Figs 10–17.

Table 1. Chaetotaxy of *Eosentomon rishir* sp. nov.

	Dorsal		Ventral	
	Formula	Composition of setae	Formula	Composition of setae
Thorax				
I	4	1, 2	6-2	A1, 2, 3, M
			6	P1, 2, 3
II	6	A2, 4, M	6-2	A1, 2, 3, M
	16	P1, 1a, 2, 2a, 3, 3a, 4, 5	6	P1, 2, 3
III	6	A2, 4, M	6-4	A1, 2, 3, M1, 2
	20	P1, 1a, 2, 2a, 3, 3a, 4, 5, 5a, 5a'	8	P1, 2, 2a, 3
Abdomen				
I	4	A1, 2	4	A1, 2
	12	P1, 1a, 2, 3, 3a, 3a'	4	P1, 2
II-III	10	A1, 2, 3, 4, 5	6	A1, 2, 3
	16	P1, 1a, 2, 2a, 3, 4, 4a, 5	4	P1, 2
IV-VI	6	A1, 2, 4	6	A1, 2, 3
	16	P1, 1a, 2, 2a, 3, 4, 4a, 5	10	P1, 2, 2a, 2a', 3
VII	2	A4	6	A1, 2, 3
	16	P1, 1a, 2, 2a, 3, 4, 4a, 5	10	P1, 2, 2a, 2a', 3
VIII	6	M2, 4, 5	0	
	9	Pc, 1a, 1a', 2, 2a	7	Pc, 1, 1a, 2
IX-X	8	1, 2, 3, 4	6	1, 1a, 2
XI	8	1, 2, 3, 4	8	1, 2, 3, 4
XII	9		12	

reticulation (Fig. 15); those of tergites V and VI small, with no reticulation (Fig. 16). Serrate lines present on sternite XII. On female squama genitalis (Fig. 17), caput processus distally contracted and curved towards median edge of stylus, corpus processus developed, filum processus of medium length.

Type series. Holotype: female, Kutsugata, Rishiri-cho, Rishiri Is., Hokkaido, 45°10'48"N, 141°10'38"E, 200 m alt., evergreen coniferous forest dominated by *Abies sachalinensis* (Fr. Schm.) Masters and *Picea jezoensis* (Sieb. et Zucc.) Carrière, 21-VI-2000, T. Maehara leg. Paratypes: two males and three females, same data as for holotype; one female, Kutsugata, Rishiri-cho, Rishiri Is., Hokkaido, 45°10'44"N, 141°11'38"E, 400 m alt., evergreen coniferous forest dominated by *A. sachalinensis* and *P. jezoensis* with *Sasa* sp. as ground cover, 20-VI-2000, T. Maehara leg.

The holotype (NSMT-Ap 364) and six paratypes (NSMT-Ap 365-370) are deposited in the collection of the Natural Science Museum, Tokyo.

Etymology. The specific epithet, a noun in apposition, is derived from an Ainu word, rishir, meaning a height or an island with a high mountain. It is the origin of the name of Rishiri Island.

Remarks. The present new species is characterized by the position of foretarsal sensillum *c'*, which is situated proximally to the base of $\alpha 6$, and the absence of A5 on abdominal tergites IV-VII. It is therefore closely similar to *E. kimum* Imadaté, 1964 and *E. nupri* Nakamura, 1983 from Japan (Hokkaido) (cf. Imadaté 1964; Nakamura 1983), but it is distinguished from these two species by the shapes of P1a on abdominal tergites II-VII (delicate and/or linear in *E. kimum* and *E. nupri*) and of foretarsal sensillum *b* (thin in *E. kimum* and *E. nupri*). *Eosentomon rishir* is sep-

arated from *E. kimum* also by the shape of foretarsal sensilla *b'1* and *c'* (thin in *E. kimum*), and from *E. nupri* by the shape of the female squama genitalis (rods in corpus processus united to form a V-shape in *E. nupri*) and the chaetotaxy of the abdominal tergites VI (A2 absent in *E. nupri*).

The absence of P5 on abdominal tergites IV (or V)–VII is observed also in *E. depilatum* Bonet, 1950 from Mexico, *E. kamenickiense* Rusek, 1974 from the Czech Republic (Bohemia), *E. microphthalmus* Tuxen, 1978 and *E. subnudum* Tuxen, 1978 from the Seychelles, *E. noonadanae* Tuxen and Imadaté, 1975 from the Bismarck Archipelago, and *E. pratense* Rusek, 1973 from the Czech Republic (Moravia), Poland, and Yugoslavia (Rusek 1973, 1974; Szeptycki 1985; Tuxen 1964, 1978; Tuxen and Imadaté 1975). The present new species is easily distinguishable from these by the shape and/or position of P1a on abdominal tergites II–VII (not capitulate and posterior to P1–2 in these species), the position of foretarsal sensillum *c'* (anterior to the base of $\alpha 6$ in these species), the shape of *b*, *t2*, and *b'2* (not spatulate in these species), and the absence of *b'1* (present in five of these species aside from *E. microphthalmus*).

This new species resembles *E. stumpfi* Rusek, 1988 from Germany in having capitulate P1a on abdominal tergite VII, but is easily distinguished from the latter (cf. Rusek 1988) in the shape and position of P1a on II–VI (longer than P1 and situated at the posterior margin in *E. stumpfi*), the presence of A5 on IV–VII, the position and/or shape of foretarsal sensilla *c'*, *b*, *t2*, and *b'2*, and the absence of *b'1*.

Some chaetotaxial variation was observed within the new species. P5a and P5a' on thoracic tergite II were present in one female. On abdominal tergites IV and VI of one female, one P1a was delicate and situated somewhat posteriorly to P1 and P2.

Posterior setae P5 on abdominal tergites IV–VII were displaced anteriorly and situated at almost the same level with A4. This character state was observed in *E. nupri* as well (Nakamura 1983). Both species lack A5 on those tergites. Although *E. kimum* also lacks A5 on those tergites, the position of P5 was not described in either Imadaté's (1964) original description or his monograph (Imadaté 1974). It is regrettable that the holotype (NSMT-Ap 4) of *E. kimum* was not in good condition and the position of P5 on IV–VII could not be observed. Therefore, I examined two other males of this species (NSMT-Ap 121, Nishi-shibetsu, Shibetsu-shi, Hokkaido, 3-IX-1969, identified by the late Dr. Imadaté), and found that they had P5 of these tergites in the same position as *E. rishir* and *E. nupri* do.

Key to the Japanese species of *Eosentomon*

1. Empodium of hind tarsus long, exceeding 1/2 of claw length
 *E. udagawai* Imadaté, 1961
- Empodium of hind tarsus normal, shorter than 1/5 of claw length 2
2. Pseudoculus with a few groups of minute globules 3
- Pseudoculus without globules..... 4
3. Foretarsal sensillum *b'1* absent.....*E. toi* Imadaté, 1964
- Foretarsal sensillum *b'1* present.....*E. tokui* Imadaté, 1974
4. Foretarsal sensillum *b'1* absent 5
- Foretarsal sensillum *b'1* present 7
5. Foretarsal sensillum *t1* nearer to $\alpha 3'$ than to $\alpha 3$; P1a on abdominal tergite VII level with P1–2.....*E. kumei* Imadaté and Yosii, 1959

- Foretarsal sensillum *t1* nearer to $\alpha 3$ than to $\alpha 3'$; P1a on abdominal tergite VII posterior to P1-2 6
- 6. Tergite V with four pairs of anterior setae (A1, A2, A4, and A5); six setae on sternites IX-X *E. topochi* Imadaté, 1964
- Tergite V with five pairs of anterior setae (A1-5); four setae on sternites IX-X....
..... *E. yezoense* Nakamura, 1983
- 7. A5 absent on abdominal tergites IV-VI; foretarsal sensillum *b'1* nearer to $\delta 3'$ than to $\delta 4'$ 8
- A5 present on abdominal tergites IV-VI; foretarsal sensillum *b'1* halfway between $\delta 3'$ and $\delta 4'$ 10
- 8. Foretarsal sensilla *b'1* and *c'* thin; P1a on tergites II-VI long and posterior to P1-2 *E. kimum* Imadaté, 1964
- Foretarsal sensilla *b'1* and *c'* thick; P1a on tergites II-VI short and level with P1-2 9
- 9. A2 on tergite VI present; foretarsal sensillum *b* spatulate *E. rishir* sp. nov.
- A2 on tergite VI absent; foretarsal sensillum *b* linear ... *E. nupri* Nakamura, 1983
- 10. P1a on abdominal tergite VII level with P1-2... *E. sakura* Imadaté and Yosii, 1959
- P1a on abdominal tergite VII posterior to P1-2 11
- 11. Sternite VIII with anterior setae 12
- Sternite VIII without anterior setae 14
- 12. Tergite VII with four pairs of anterior setae (A1, A2, A4, and A5).....
..... *E. konsenense* Imadaté, 1994
- Tergite VII with two pairs of anterior setae (A4 and A5) 13
- 13. Foretarsal sensillum *t1* nearer to $\alpha 3'$ than to $\alpha 3$; *a'* level with $\alpha 3$
..... *E. asahi* Imadaté, 1961
- Foretarsal sensillum *t1* nearer to $\alpha 3$ than to $\alpha 3'$; *a'* level with *t1*.....
..... *E. juni* Imadaté, 1994
- 14. Sternite VIII with posterior central seta (Pc) 15
- Sternite VIII without posterior central seta 16
- 15. Foretarsal sensillum *t1* nearer to $\alpha 3$ than to $\alpha 3'$; abdominal tergites V-VI with three pairs of anterior setae (A1, A4, and A5) *E. tokiokai* Imadaté, 1964
- Foretarsal sensillum *t1* between $\alpha 3$ and $\alpha 3'$; abdominal tergites V-VI with two pairs of anterior setae (A4 and A5) *E. dounanense* Imadaté, 1994
- 16. Foretarsal sensillum *t1* nearer to $\alpha 3$ than to $\alpha 3'$; abdominal tergites VI and VII with two pairs (A4 and A5) and one pair (A5) of anterior setae, respectively
..... *E. pacificum* Imadaté and Yosii, 1959
- Foretarsal sensillum *t1* nearer to $\alpha 3'$ than to $\alpha 3$; abdominal tergites VI and VII with four pairs (A1, A2, A4, and A5) and two pairs (A4 and A5) of anterior setae, respectively *E. asakawaense* Imadaté, 1961

Acknowledgements

I am indebted to Dr. H. Ono, National Science Museum, Tokyo, for arranging the loan of the specimens of *E. kimum*, Drs. H. Tamura and A. Szeptycki for reading through the manuscript and giving valuable advice, and Dr. J. Rusek for his kind response to my inquiry. I sincerely thank anonymous reviewers for reading the manuscript carefully, and Mr. K. Furuno and Mr. T. Maehara for their cooper-

ation in collecting the specimens. The materials used here were all collected with the permission (permit no. 408) of the Ministry of the Environment, Japan.

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